

# 7

Science Standard  
7.3.a.



# Shaping Natural Systems through Evolution

## California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

### The Education and the Environment Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency  
California Natural Resources Agency  
Office of the Secretary of Education  
California State Board of Education  
California Department of Education  
California Integrated Waste Management Board

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### Key Partners:

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**Adaptation:** A change in the body or behavior of a species in response to a new environmental condition. Adaptation occurs over several generations.

**Byproduct:** Something, such as waste materials or chemicals, produced when something else is manufactured or consumed.

**Climate:** The prevailing, average weather conditions of a particular area over time.

**Clone:** An organism that is genetically identical to its parent.

**Diversity:** A measure of the variation of life forms at the genetic, species, or ecosystem level.

**DNA:** Deoxyribonucleic acid, the molecule that carries all of the genetic information in a living organism.

**Elevation:** Height above sea level.

**Endemic:** (noun) Something that is only found in a specified geographic region. (adjective) Occurring naturally in a particular region.

**Endemic species:** An organism that is only found in a specified geographic region.

**Environmental factors:** The biotic and abiotic components of the environment.

**Evolution:** The process by which species develop as a result of natural selection for beneficial adaptations. Evolution occurs over many generations.

**Extinct:** No longer existing as a species or subspecies.

**Extinction:** The death of all members of a species or other taxa.

**Gene:** A portion of a DNA molecule that instructs the cell to make a specific protein.

**Gene pool:** The variety of genes found within a population of organisms.

**Genetic variation:** Differences in the genetic makeup within a population or species.

**Habitat:** The place where an organism lives and meets its needs.

**Heritable:** The types of traits that can be passed from parent to offspring through the genes.

**Human activities:** The things that individual people, communities, and societies do, such as the harvesting or extracting of materials and the production of goods.

**Inheritance:** The process by which genetic traits are passed from parents to offspring.

**Microclimate:** The climate of a small, specific place as contrasted within a larger area.

**Mutation:** A change to an organism's DNA sequence.

**Natural selection:** The process by which individuals with advantageous variations survive and reproduce.

**Organism:** A living thing, such as a plant, animal, or other life form, capable of metabolic activity and reproduction.

**Population:** The number of individuals of a species in an area.

**Protective coloration:** An adaptation by which an organism's color makes it less noticeable to predators.

**Purebred:** Organisms that result from selective breeding for specific characteristics over many generations.

**Reproduction:** The process an organism goes through to produce new individuals of its own kind.

**Sexual reproduction:** The type of reproduction whereby offspring inherit genes from both parents.

**Speciation:** The process through which new species are formed.

**Species:** Genetically related organisms that resemble one another and can successfully reproduce.

**Subspecies (abbreviation, ssp.):** A group of organisms within a species that has distinct characteristics from other populations of that species.

**Trait:** A distinguishing characteristic, such as color, or behavior, such as the ability to run quickly.

**Variation:** Differences in genetic or behavioral traits within a species.

**Vegetative propagation:** Asexual reproduction of plants involving the use of stems, roots, or leaves, rather than seeds or spores, to produce new plants.

**Viable:** Having the potential to live, grow, develop, and function adequately.

**Wild-type:** An organism that has genes and traits very similar to those of other members of the species that live in the wild.

**Prompt:** How do these fish differ from one another, in terms of color, size, markings, and shape?

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Name: \_\_\_\_\_

### Part 1

**Instructions:** Read the prompts below and complete the tasks in the spaces provided. (2 points each)

The fish on your table represent different members of one species of pupfish. These fish lived 25,000 years ago.

1. List three different traits that can be used to describe a pupfish.

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2. Human beings are all members of the same species, but individuals of the species have different traits. List three inherited traits that a person might have that can be different in another individual in this species.

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### Part 2

**Instructions:** Use your **Environment Card** and **Sample Pupfish** to help answer the questions below. (2 points each)

#### Environment #1:

1. What is the name of the environment?

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2. Describe this environment.

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## Evolution of Pupfish

Lesson 1 | page 2 of 4

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Name: \_\_\_\_\_

3. Which fish will not survive in this environment, if any? Why?

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4. Of the fish that will survive, which will be the most successful at reproducing? Why?

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5. A fish that survives and reproduces passes on its traits to its offspring. What trait or traits are most likely to be passed on to the next generation in this environment?

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### Environment #2:

1. What is the name of the environment?

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2. Describe this environment.

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3. Which fish will not survive in this environment, if any? Why?

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4. Of the fish that will survive, which will be the most successful at reproducing? Why?

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Name: \_\_\_\_\_

5. A fish that survives and reproduces passes on its traits to its offspring. What trait or traits are most likely to be passed on to the next generation in this environment?

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**Environment #3:**

1. What is the name of the environment?

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2. Describe this environment.

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3. Which fish will not survive in this environment, if any? Why?

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4. Of the fish that will survive, which will be the most successful at reproducing? Why?

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5. A fish that survives and reproduces passes on its traits to its offspring. What trait or traits are most likely to be passed on in this environment?

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Name: \_\_\_\_\_

### Part 3

**Instructions:** Complete the following tasks in the spaces provided. (2 points each)

1. Define “adaptation” in your own words.

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2. What is an example of an adaptation in one of the pupfish from Part 2?

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3. Define “natural selection” in your own words.

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4. Define “evolution” in your own words.

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5. What makes a trait become more common in future generations?

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6. If a trait makes an organism more likely to survive, will it always be passed on to future generations? Why or why not?

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Name: \_\_\_\_\_

**Instructions:** Read and respond to the prompt as directed during the lesson.

**Topic:** Evolution notes

**Prompt:** Hypothesize why the *Tegula* snails seem to live in different places and what might be causing this difference.

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**Instructions:** Summarize what you learned, based on the **Evolution Notes** visual aids.

**Notes on Variation:**

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**Notes on Environment:**

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**Notes on Natural Selection:**

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## Evidence of Evolution

### Lesson 2

Name: \_\_\_\_\_

**Instructions:** Use the information in **Evolution Research Projects #1–4** to complete the chart below. (1 point for each cell)

	Research Project 1: Purple Pitcher Plant Mosquitoes	Research Project 2: Kauai Field Crickets	Research Project 3: <i>E. coli</i> Bacteria	Research Project 4: Guppies
What trait did the researchers study?				
How did this trait vary in the population?				
What environmental condition or environmental change put selection pressure on this trait?				
Which version of the trait is most adaptive for this environment?				
Why is this variation of the trait considered an adaptation?				
How has the population evolved over time?				

**Instructions:** Read and respond to the prompt as directed during the lesson.

**Prompt:** Think about the many different people in our class. What are three examples of genetic variation in humans?

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

## Variation and Natural Selection

### Lesson 3 | page 1 of 4

Name: \_\_\_\_\_

**Instructions:** Play Rounds 1 to 4 and record your findings in the charts below.

#### Round 1

Environmental factors: It has been an average weather season in Origami Bird Land. There has been a mix of food types, both large and small.

Name of bird (student)	Small or large beak?	Number of rice grains eaten	Number of marbles eaten	Did it survive?	How many offspring did it have?

After Round 1, there were: \_\_\_\_\_ small-beaked birds \_\_\_\_\_ large-beaked birds

#### Round 2

Environmental factors: It has been a very wet season in Origami Bird Land. Small food (rice) are very plentiful. There is less large food (marbles or beads).

Name of bird (student)	Small or large beak?	Number of rice grains eaten	Number of marbles eaten	Did it survive?	How many offspring did it have?

After Round 2, there were: \_\_\_\_\_ small-beaked birds \_\_\_\_\_ large-beaked birds

## Variation and Natural Selection

### Lesson 3 | page 2 of 4

Name: \_\_\_\_\_

#### Round 3

Environmental factors: It has been a very dry season in Origami Bird Land. There is mainly large-size food; almost all of the small-sized food is gone.

Name of bird (student)	Small or large beak?	Number of rice grains eaten	Number of marbles eaten	Did it survive?	How many offspring did it have?

After Round 3, there were: \_\_\_\_\_ small-beaked birds \_\_\_\_\_ large-beaked birds

#### Round 4

Environmental factors: \_\_\_\_\_

Name of bird (student)	Small or large beak?	Number of rice grains eaten	Number of marbles eaten	Did it survive?	How many offspring did it have?

After Round 4, there were:  
\_\_\_\_\_ small-beaked birds \_\_\_\_\_ large-beaked birds \_\_\_\_\_ very large-beaked birds

Name: \_\_\_\_\_

**Instructions:** Using information from today's lesson, answer the following questions.  
(2 points each)

1. What kinds of birds survived and reproduced in a rainy climate? Which reproduced the most?

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2. What kinds of birds survived and reproduced in a dry climate? Which reproduced the most?

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3. What would happen if there were only small-beaked birds in a dry climate? Why?

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## Variation and Natural Selection

Lesson 3 | page 4 of 4

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Name: \_\_\_\_\_

4. If the only kinds of food available were very large (larger than the marbles), what would happen to the bird population that existed at the end of Round 2? Why?

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5. If the only kinds of food available were very large (larger than the marbles), what would happen to the bird population after Round 4? Why?

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6. Is there a “best” kind of bird beak? Why or why not?

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**Prompt:** We have seen how species evolve differently depending on environmental conditions over time. Different features of an environment make particular variations of a trait adaptive for a species. What is one example of this principle from our unit so far?

[illegible]

Name: \_\_\_\_\_

### Part 1

**Instructions:** Use the chart below to describe different environments in California. For each row:

1. Use the latitude and longitude to find the location on the **Political** wall map.
2. Use the colors on the map to find the elevation at this location. Describe the elevation using the categories “low,” “medium,” “high,” or “very high.”
3. Use the “Geographic Regions of California” map on the **Political** wall map to determine the name of the region of this location. Describe whether the geology of this region contains mountains, valleys, or deserts, or whether it is on the coast.
4. Use **California’s Climate Zones**, Student Edition page 12, to find the climatic zone for this location. Use the **Climate Glossary** to learn what each zone means. Describe the climatic zone in your own words.

Location	Elevation: Low = 0–1,000 feet Medium = 1,000–5,000 feet High = 5,000–10,000 feet Very High = over 10,000 feet	Geographical Region: List the name and describe it (mountains, valley, desert, coast)	Climate: Describe the climate.
<b>Orick</b> (41.3° N, 124.1° W)			
<b>Yosemite Village</b> (37.7° N, 119.6° W)			
<b>Preston Peak</b> (41.8° N, 123.6° W)			
<b>Forestville</b> (38.5° N, 122.9° W)			
<b>Madera</b> (36.9° N, 120.1° W)			
<b>White Mountain Peak</b> (37.6° N, 118.3° W)			
<b>Blythe</b> (33.6° N, 114.6° W)			
<b>Redondo Beach</b> (33.8° N, 118.4° W)			

Name: \_\_\_\_\_

## Part 2

**Instructions:** Read the description of each plant or animal on the **California Species Descriptions**. Look at the adaptations these species have. Think about what environmental factors would cause these adaptations to be selected over time. Match each species with its correct environment. Put the letter of the matching location next to the correct species.

American pikas live near Location \_\_\_\_\_

Blunt-nosed lizards live near Location \_\_\_\_\_

Desert kangaroo rats live near Location \_\_\_\_\_

El Segundo blue butterflies live near Location \_\_\_\_\_

Coastal redwoods live near Location \_\_\_\_\_

Giant sequoias live near Location \_\_\_\_\_

McDonald's rockcress lives near Location \_\_\_\_\_

Pitkin's marsh lilies live near Location \_\_\_\_\_

- A. Blythe
- B. Forestville
- C. Madera
- D. Orick
- E. Preston Peak
- F. Redondo Beach
- G. White Mountain Peak
- H. Yosemite Village

## Part 3

**Instructions:** Answer the following questions in the spaces provided. (2 points each)

- Pick a species from the list above and answer the questions below about that species.

What is an adaptation that this species has?

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What kind of environmental factor would exert selection pressure for this trait and make the trait adaptive?

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Name: \_\_\_\_\_

2. Why does California have such a diversity of species?

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**Instructions:** Many of the species you studied today live in environments that are changing. Read about each change below. Think about what you know about evolution, and predict what you think could happen to this species in response to this change. (2 points each)

3. Temperatures at very high elevations have been getting warmer. How do you think this could affect the evolution of the American Pika?

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4. Scientists have been planting more coastal buckwheat on beaches. How do you think this could affect the El Segundo blue butterfly?

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Name: \_\_\_\_\_

**Instructions:** Read and respond to the prompts as directed during the lesson.

**Topic:** Human Activities and Evolution

**Prompt 1:** How did humans affect the reproduction process of bananas?

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**Prompt 2:** How did human activity affect the genetic variation of the banana?

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**Prompt 3:** Which population of banana would be more likely to survive a change in the environmental conditions? Wild bananas or the type of banana at your table?

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Name: \_\_\_\_\_

**Instructions:** Complete the chart below with information from **Resource Readings**. (1 point per cell)

	Greater Prairie Chicken	Lumper Potatoes
List the human activities that have affected this species.		
How did human actions cause this species' environment to change?		
Did human actions cause genetic variation in this species to change? How?		
What was the effect of these changes on the evolution of this species?		

Name: \_\_\_\_\_

	Northern Elephant Seals	Sweet Vernal Grass
List the human activities that have affected this species.		
How did human actions cause this species' environment to change?		
Did human actions cause genetic variation in this species to change? How?		
What was the effect of these changes on the evolution of this species?		

**Instructions:** Read and respond to the prompts as directed during the lesson.

**Prompt:** Think about all the species we have studied in this unit. Select one that has been affected by human activity. Describe the activity. What effect did this activity have on the evolution of the species?

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Name: \_\_\_\_\_

## Part 1

**Instructions:** Complete the two flowcharts below, one for each species of pupfish (Tecopa pupfish and Devil’s Hole pupfish). (5 points each flowchart)

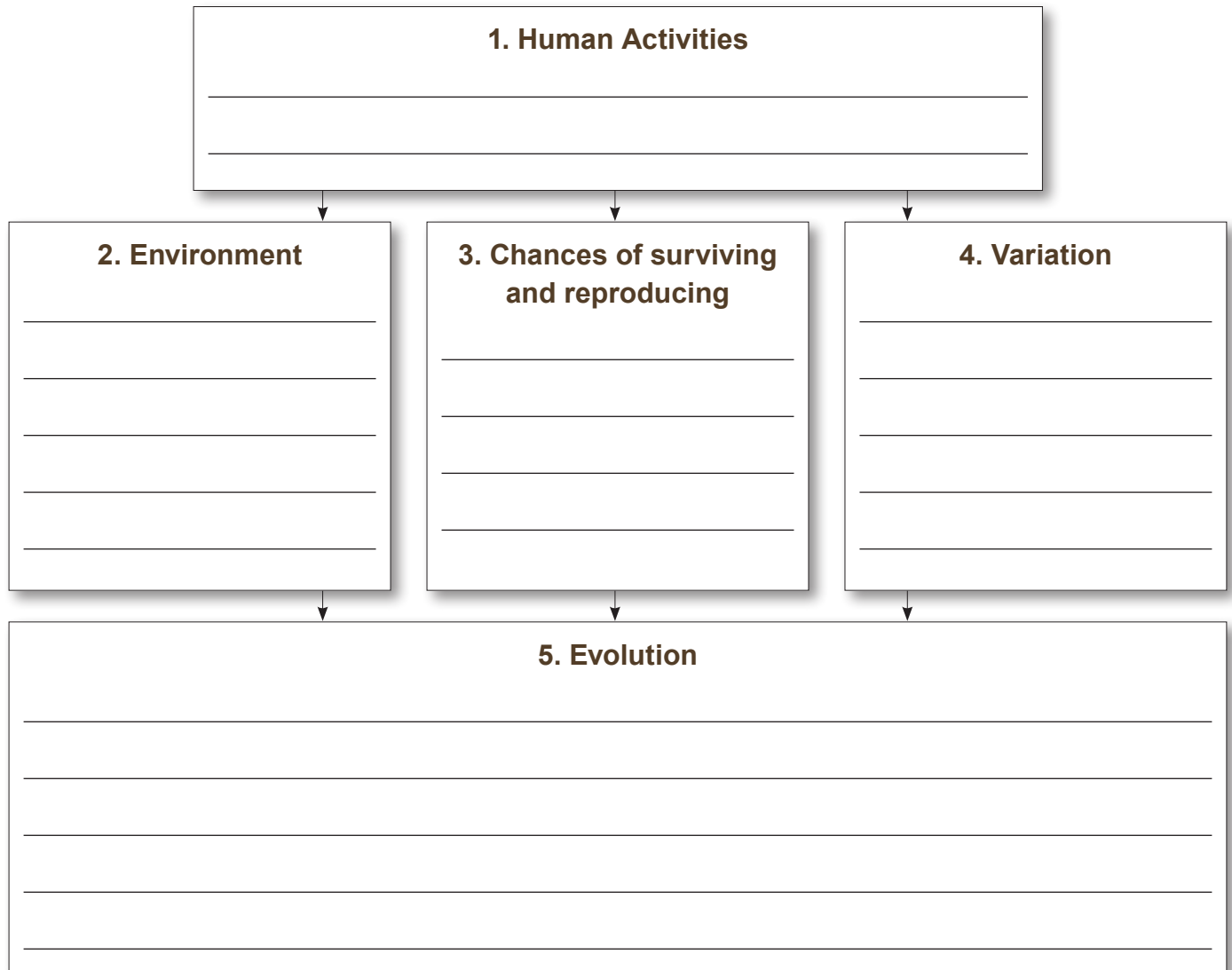
- In the first section, describe the kinds of human activities that have affected these fish. Think about how these activities have affected the species.
- In the second section, describe how the species’ environment has changed.
- In the third section, describe how the species’ chances of surviving and reproducing have changed.
- In the fourth section, describe the species’ level of genetic variation. If humans altered this level of variation, how did that happen?
- In the fifth section, summarize how human activity has affected the evolution of each species of pupfish. Use the word “adaptation” in your paragraph.

### The Tecopa Pupfish

<b>1. Human Activities</b> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/>		
<b>2. Environment</b> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/>	<b>3. Chances of surviving and reproducing</b> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/>	<b>4. Variation</b> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/>
<b>5. Evolution</b> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/>		

Name: \_\_\_\_\_

## The Devil's Hole Pupfish



Name: \_\_\_\_\_

**Part 2**

**Instructions:** Read the following list of species and human activities that have influenced their evolution. Circle one of these to use for the flowchart on the next page.

Species	Human Activity
<b>American pika</b>	Many activities, including driving cars and running factories, have put gases, such as carbon dioxide into the air. These gases have caused the temperature on Earth to increase.
<b>El Segundo blue butterfly</b>	Developers destroyed much of the coastal dune environment near Los Angeles. Recently, they have started planting coastal buckwheat plants along the remaining dunes.
<b>Kauai field crickets</b>	Humans brought the fly, <i>Ormia ochracea</i> , to Kauai.
<b>McDonald's rockcress</b>	People mine mountainous areas that contain heavy metal. In the past, people have mined nickel in the area where McDonald's rockcress lives. People also drive off-road vehicles in the mountains. These can crush plants.
<b>Purple pitcher plant mosquitoes</b>	Many activities, including driving cars and running factories, have put gases, such as carbon dioxide into the air. These gases have caused the temperature on Earth to increase.

**Instructions:** Complete the flowchart on the next page for the species you selected.  
(2 points per section, 10 total)

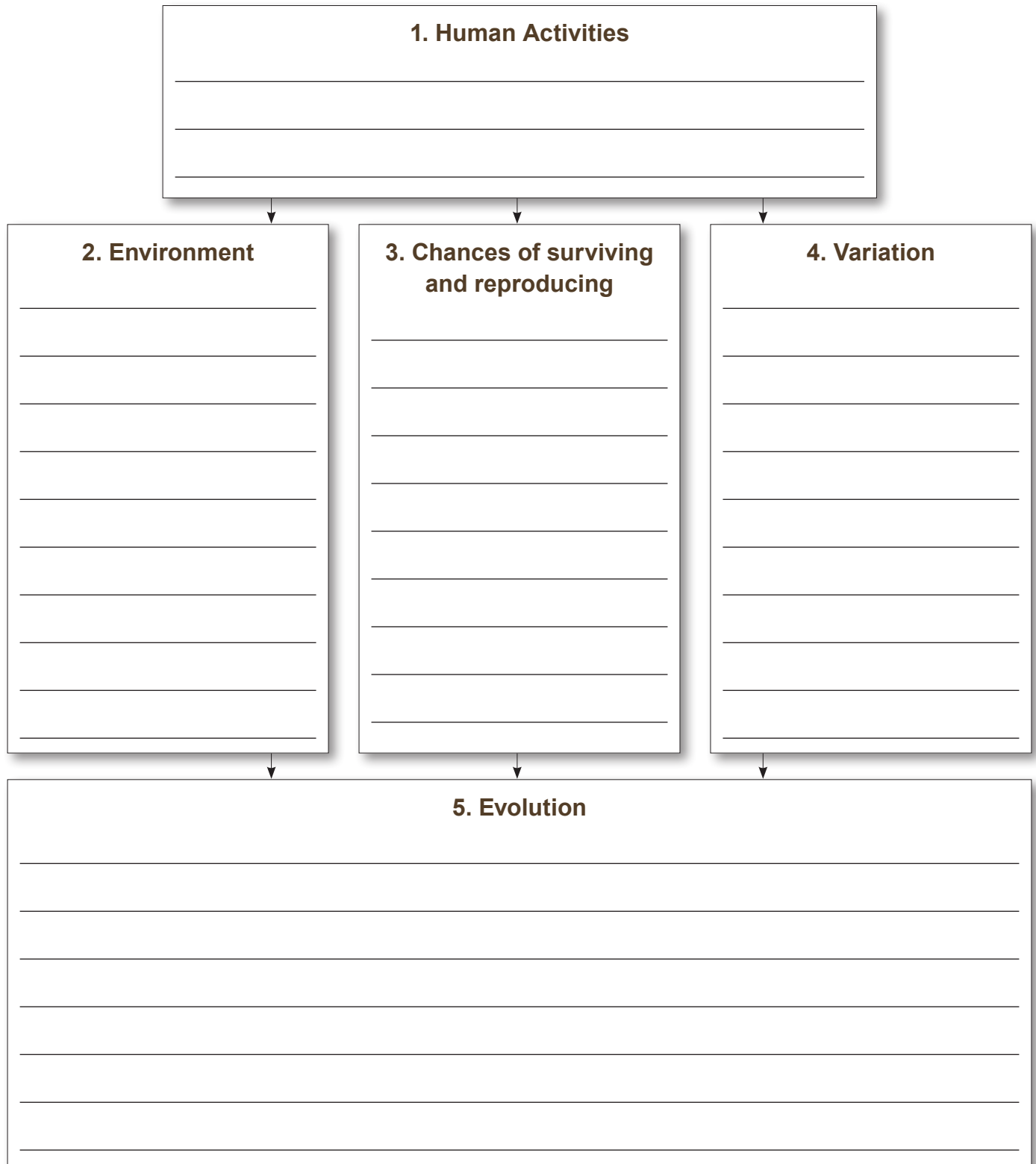
- In the first section, describe the kinds of human activities that have affected the species. Think about how these activities have affected the species.
- In the second section, describe how the species' environment has changed.
- In the third section, describe how the species' chances of surviving and reproducing have changed.
- In the fourth section, describe the species' level of genetic variation. If humans altered this level of variation, how did that happen?
- In the fifth section, summarize how human activity has affected the evolution of this species. Use the word "adaptation" in your answer.

## Summary: Human Influence on Evolution

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Name: \_\_\_\_\_

Species: \_\_\_\_\_









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